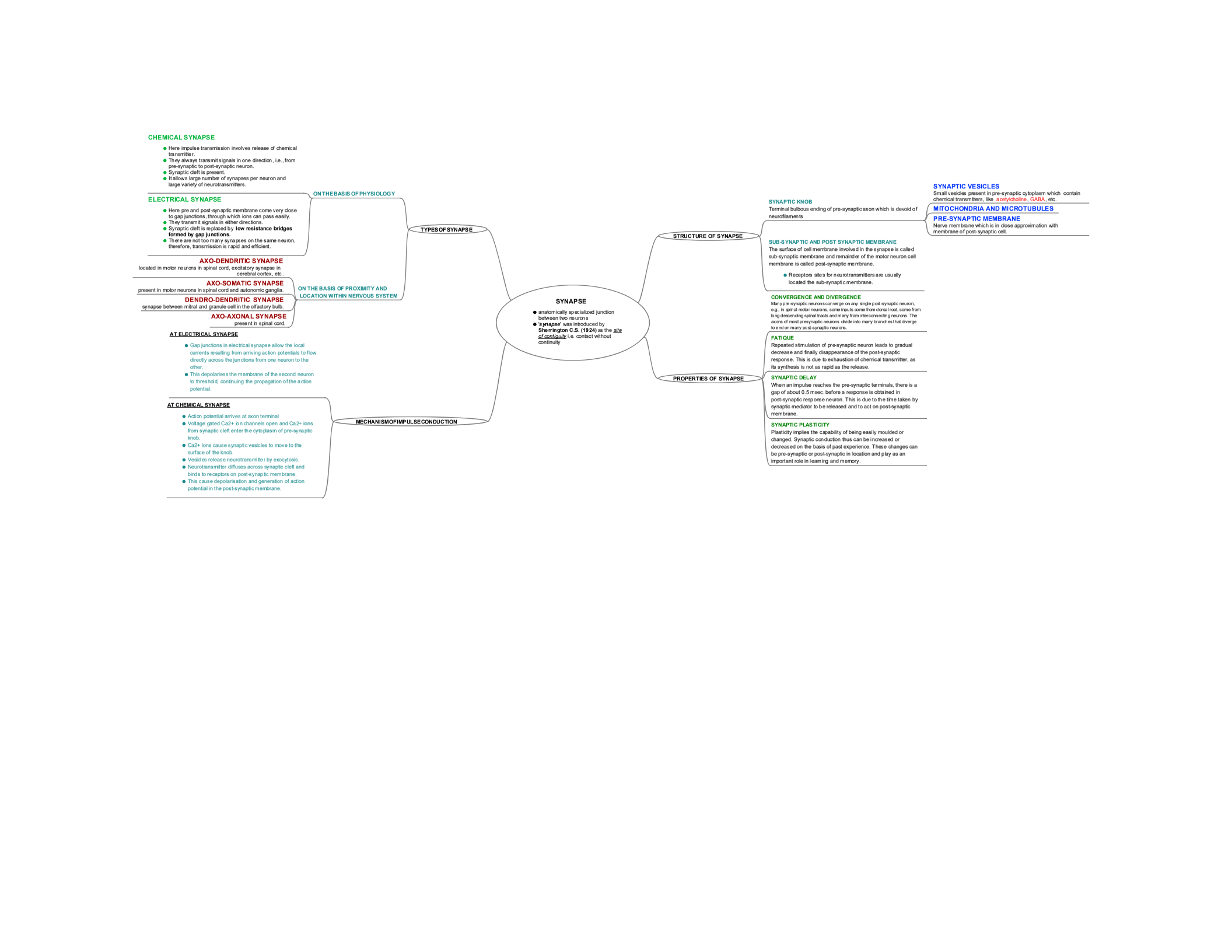
SYNAPSE
anatomically specialized junction between two neurons
'synapse' was introduced by Sherrington C.S. (1924) as the site of contiguity i.e. contact without continuity
TYPES OF SYNAPSE
ON THE BASIS OF PHYSIOLOGY
CHEMICAL SYNAPSE
Here impulse transmission involves release of chemical transmitter.
They always transmit signals in one direction, i.e., from pre-synaptic to post-synaptic neuron.
Synaptic cleft is present.
It allows large number of synapses per neuron and large variety of neurotransmitters.
ELECTRICAL SYNAPSE
Here pre and post-synaptic membrane come very close to gap junctions, through which ions can pass easily.
They transmit signals in either directions.
Synaptic cleft is replaced by low resistance bridges formed by gap junctions.
There are not too many synapses on the same neuron, therefore, transmission is rapid and efficient.
ON THE BASIS OF PROXIMITY AND LOCATION WITHIN NERVOUS SYSTEM
AXO-DENDRITIC SYNAPSE
located in motor neurons in spinal cord, excitatory synapse in cerebral cortex, etc.
AXO-SOMATIC SYNAPSE
present in motor neurons in spinal cord and autonomic ganglia.
DENDRO-DENDRITIC SYNAPSE
synapse between mitral and granule cell in the olfactory bulb.
AXO-AXONAL SYNAPSE
present in spinal cord.
MECHANISM OF IMPULSE CONDUCTION
AT ELECTRICAL SYNAPSE
Gap junctions in electrical synapse allow the local currents resulting from arriving action potentials to flow directly across the junctions from one neuron to the other.
This depolarises the membrane of the second neuron to threshold, continuing the propagation of the action potential.
AT CHEMICAL SYNAPSE
Action potential arrives at axon terminal
Voltage gated Ca2+ ion channels open and Ca2+ ions from synaptic cleft enter the cytoplasm of pre-synaptic knob.
Ca2+ ions cause synaptic vesicles to move to the surface of the knob.
Vesicles release neurotransmitter by exocytosis.
Neurotransmitter diffuses across synaptic cleft and binds to receptors on post-synaptic membrane.
This cause depolarisation and generation of action potential in the post-synaptic membrane.
STRUCTURE OF SYNAPSE
SYNAPTIC KNOB
Terminal bulbous ending of pre-synaptic axon which is devoid of neurofilaments
SYNAPTIC VESICLES
Small vesicles present in pre-synaptic cytoplasm which contain chemical transmitters, like acetylcholine, GABA, etc.
MITOCHONDRIA AND MICROTUBULES
PRE-SYNAPTIC MEMBRANE
Nerve membrane which is in close approximation with membrane of post-synaptic cell.
SUB-SYNAPTIC AND POST SYNAPTIC MEMBRANE
The surface of cell membrane involved in the synapse is called sub-synaptic membrane and remainder of the motor neuron cell membrane is called post-synaptic membrane.
Receptors sites for neurotransmitters are usually located the sub-synaptic membrane.
PROPERTIES OF SYNAPSE
CONVERGENCE AND DIVERGENCE
Many pre-synaptic neurons converge on any single post-synaptic neuron, e.g., in spinal motor neurons, some inputs come from dorsal root, some from long descending spinal tracts and many from interconnecting neurons. The axons of most presynaptic neurons divide into many branches that diverge to end on many post-synaptic neurons.
FATIQUE
Repeated stimulation of pre-synaptic neuron leads to gradual decrease and finally disappearance of the post-synaptic response. This is due to exhaustion of chemical transmitter, as its synthesis is not as rapid as the release.
SYNAPTIC DELAY
When an impulse reaches the pre-synaptic terminals, there is a gap of about 0.5 msec. before a response is obtained in post-synaptic response neuron. This is due to the time taken by synaptic mediator to be released and to act on post-synaptic membrane.
SYNAPTIC PLASTICITY
Plasticity implies the capability of being easily moulded or changed. Synaptic conduction thus can be increased or decreased on the basis of past experience. These changes can be pre-synaptic or post-synaptic in location and play as an important role in learning and memory.